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THE SCIENTIFIC STUDY OF MAMMALS.

The Age of Mammals in Europe, Asia, and North America. By Prof. Henry Fairfield Osborn. Pp. xvii+635, with illustrations. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 18s. 6d. net.

DURING recent years no branch of study has made more important contributions to biology than that of extinct mammals. It has not only led to a more satisfactory understanding of the mammals themselves and their relationships. It has also thrown unexpected light on the general processes of organic evolution and the problems of geographical distribution. The broad features in the secular development of several groups of mammals are now better known than the growth stages in the individual life-history of many common existing species; and the underlying principles are often discoverable from a consideration of the numerous recurring phenomena which are sufficiently well known for comparison.

The literature of the subject, however, has become so voluminous and scattered that the time has arrived for an exhaustive critical summary. The aimless casual descriptions of so-called new species and varieties can only be superseded by real contributions to science when the present position of the various problems is clearly understood. Zoologists, especially palæontologists, are therefore much indebted to Prof. H. F. Osborn for the great labour he has bestowed on his new work, "The Age of Mammals," which furnishes the necessary summary by a master-hand and forms a sure basis for future research.

Prof. Osborn's volume is intended for general scientific readers as well as for specialists. It is thus prefaced by an interesting introductory section on the principles of palæontology as illustrated by extinct mammals, and on certain related geological questions. The treatment is more or less historical, with full references to the original authors, and there are several explanatory diagrams and maps. A table of strata (Fig. 13) marking the periods of successive earth-disturbances which gave rise to various mountain-systems, is especially striking. During the "Age of Mammals," or Tertiary period, the Pyrenees, Swiss Alps, and Himalayas have been formed in the Old World, while the Rocky Mountains have originated in North America.

It is well known that mammals first arose during the Secondary period, or "Age of Reptiles," but remained insignificant and restricted in their range until practically all the dominant reptiles had passed away. Prof. Osborn alludes more than once to this apparently sudden world-wide extinction of the dinosaurs, ichthyosaurs, plesiosaurs, and pterodactyls which flourished until the end of Cretaceous times; but it is only to emphasise the inexplicable nature of the phenomenon. As he remarks,

"Reptiles are so sensitive to temperature that it is natural to attribute this extinction to a general refrigeration, but the flora shows no evidence of this

either in Europe or America; nor is there evidence of any great geographic cataclysm on the surface of the earth, for the plant-life transition from one age to the other in the Rocky Mountain region is altogether gradual and gentle."

Whatever may have been the cause, so soon as the great reptiles had disappeared, small primitive mammals of the kind which arose in the Secondary period suddenly began to multiply, and spread both in Europe and North America, perhaps also in South America. Their remains are found in the Basal Eocene deposits. None of these animals, however, appear to be directly ancestral to more modern groups, the direct forerunners of which arrived both in Europe and North America from some undetermined region in the period of the Lower Eocene. This second mysterious migration furnished the source of the lemurs, insectivores, true carnivores, rodents, and perissodactyl and artiodactyl ungulates. A few of the primitive mammals still survived with them through the Eocene until the beginning of Oligocene times, most of them grown unwieldy in size, such as the herbivorous *Coryphodon* and *Uintatherium*, or the carnivorous *Mesonyx*; but their brain remained small and simple, and they could not compete with the higher mammals in which advance in brain-power accompanied progressive elaborations in the limbs and dentition.

During the Oligocene period, sabre-toothed cats, dogs, martens, pigs, and rhinoceroses became recognisable, both in Europe and North America, while the viverrines occurred in Europe; and the hares and primitive camels were characteristic of North America. Africa was then a separate land-area, the scene of the early development of hyracoids and proboscideans. In all regions there were certain precocious and aberrant types, such as the *titanotheres* of North America and *Arsinoitherium* in Egypt, which only flourished for a short time, without leaving descendants. At the beginning of the Miocene period the most noteworthy event was the connection of Africa with Europe, which allowed the proboscideans to spread over the whole of the northern hemisphere, where they flourished and increased in size. There were now true cats and bears, tapirs, and rhinoceroses, both in the Old and New Worlds; while by the end of the Miocene the horses had nearly become one-toed, and apes, antelopes, okapis, and horned deer had appeared, at least in the Old World.

By the end of the Pliocene period mammals had become much as they are now, though most of the groups were more widely distributed, and they comprised many large species which soon disappeared after the advent of man. From the early Eocene until the early Pliocene, South America had been an isolated land-area, on which mammals had developed into several strange groups of ungulates and the true edentates (sloths, armadillos, and ant-eaters). Before the end of the Pliocene, the emergence of the isthmus of Panama permitted some of these types to wander north into the southern United States, while the camels (llamas and alpacas), cats, dogs, deer, pigs, horses, and mastodons were able for the first time to spread to the southern continent. At the end of the Pliocene period

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there is evidence of extensive desiccation in western North America, southern South America, north-central Africa, and central Australia; and physical changes which are not yet understood led to a glacial epoch in the northern hemisphere in Pleistocene times. These phenomena had doubtless much to do with the extinction of the large quadrupeds and the impoverishment of the mammal fauna. Civilised man has continued the destruction.

The whole of this fascinating story is told in detail by Prof. Osborn, who not only discusses the mammals themselves, but also describes the rocks in which their remains occur, and briefly notices the successive changes in geography which they indicate. His work is illustrated by numerous text-figures of skeletons, restored sketches of extinct mammals made by the American Museum of Natural History, photographs of scenery, and diagrammatic geological sections. As might be supposed, much of it is extremely technical, and to be used for reference rather than systematic reading; but it is enlivened throughout by a succession of interesting generalisations, which are all the more valuable as having been either suggested or confirmed by the author's own researches. The peculiar feature of Prof. Osborn's book, indeed, is its stimulating freshness, and he is to be congratulated on the impulse which it is certain to give to the studies with which it deals.

A. S. W.

GEOGRAPHICAL DISTRIBUTION OF FERNS.

Die Geographie der Farne. By H. Christ (Basel)
Pp. 357+3 maps. (Jena: Gustav Fischer, 1910.)
Price 12 marks.

DR. CHRIST has produced a volume of remarkable interest on the geographical distribution of ferns, which forms a worthy companion to Schimper's well-known "*Pflanzen-Geographie auf physiologischen Grundlage*." The book has been arranged in a somewhat similar manner to Schimper's "*Plant Geography*," and is divided into two parts. The first consists of 136 pages, devoted to considerations of the effects of soil, climate, &c., on the distribution of ferns, and in the second part the ferns of the different geographical areas are described in detail.

To the general botanist, and more particularly to the ecologist, the first portion of the book has the greater interest. Ferns, unlike the flowering plants, though very widely distributed, are not universally found over the surface of the earth, since they are definitely limited as to their environment by the need for water, and though many species are remarkable for their capability of resisting desiccation, yet they are unable to grow where the rainfall is below a certain amount. Being in the main shade plants, their maximum distribution tends to follow the wooded areas of the globe; and the dry desert areas are almost destitute of ferns.

Though mainly found growing on humus, some ferns are affected by the nature of the substratum, and this is especially the case with calcareous soils. It may often happen, however, that chalk-shunning ferns may be found on that formation owing to the

depth of humus by which the calcareous soil is overlaid.

Striking examples of ferns which avoid the chalk are afforded by *Asplenium septentrionale* and by the world-wide *Pteridium aquilinum*—the bracken fern—which is found in both hemispheres, from "the equator to the poles." *Asplenium viride* and *Cystopteris montana*, on the other hand, may be cited as examples of species characteristic of the chalk. Halophytes, again, have their fern representatives, and *Acrostichum lomarioides* from the brackish swamps of tropical America, and *A. aureum*, which grows in the Rhizophora estuaries, are striking examples of this type of plant.

Then again there are the fresh-water swamp ferns, such as the widely distributed *Dryopteris thelypteris* and the well-known water fern, *Ceratopteris thalictroides*.

The majority of ferns are perennial, but there are a few exceptions, of which *Ceratopteris* is one, and also the annual fern, *Anogramma leptophylla*.

Ferns afford parallels to Phanerogams in their choice of habitats and relations to climatic conditions, and also in their external forms they provide counterparts to other types of vegetation. We find them, for example, as epiphytes; tree ferns; scramblers or bramble ferns (*Gleichenia*, *Odontosoria*, &c.); twining ferns, such as *Blechnum volubile*; tendril climbers (*Lathyropteris madagascariensis*), and creeping epiphytes or rhizome climbers, which are well illustrated by the aroid-like *Oleandra neeriformis*.

The general biological features of hygrophytic ferns, hairs, secretions, storage organs, &c., are also described with a wealth of illustration.

An interesting section is devoted to the description of the xerophytic types, many of which have their home in the Andes, on the same lines as that for the hygrophytes. Two characteristic forms may be recognised: the *Cheilanthes* type, with short rhizome, deep roots, and small hairy pinnae, and the *Elaphoglossum* type, where the rhizome is thick and creeping and the leaves tongue-like, leathery, and simple. The genera *Cyclophorus*, from the Old World, and *Elaphoglossum*, centred in the Andes, afford the most striking examples.

Ferns of high alpine or arctic regions are few, and, as compared with the phanerogamic vegetation of such situations, are not particularly characteristic. *Cryptogramma* and *Woodsia*, however, may be cited as typically northern alpine forms, while *Polystichum mohrioides* is a typical antarctic-andine species. One of the highest known species is another *Polystichum*, *P. Duthei*, from Kumaon, which occurs at an altitude of from 13,000 to 17,000 feet.

The bulk of the second part of the book is concerned with the fern flora of the different geographical regions, but it is preceded by some very interesting pages dealing with general questions of geographical distribution, such as the effect of the Ice age and the relics of the fern flora of past ages. The distribution of several genera is outlined, but space does not permit of a review of this section of the book in further detail. Attention may, however, be directed to the remarkable case of distribution afforded by